EFFECTS OF METACOGNITIVE SELF ASSESSMENT STRATEGY ON ACHIEVEMENT AND RETENTION IN CHEMSTRY AMONG SECONDARY SCHOOL STUDENTS IN MINNA, NIGER STATE, NIGERIA

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This study examines effect of metacognitive self assessment strategy on Chemistry achievement and retention among senior secondary school students in Minna, Niger state. Four research questions and four null hypotheses were formulated and tested at 0.05 level of significance. Pretest posttest nonequivalent control group Quasi experimental design was adopted for the study. Four secondary schools were randomly selected in Minna metropolis and were randomly assigned to experimental and control groups. A total of 152 SS2 students drawn from a population of 7051 subjects participated in the study which lasted for six weeks .Intact subject classes were used for the study. Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) were developed by the researchers. CAT was validated by experts in Chemistry education and the reliability coefficient 0.81 was determined using Kurder-Richardson. Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) were used for the collection of data. Data collected were analyzed using mean, standard deviation and t-test. The result of the study indicated that metacognitive self assessment strategy improved the Chemistry achievement as well as the retention of the students taught using the strategy. The result also show that the strategy is gender friendly since both male and female students in the study performed equally well. It is recommended that Chemistry teachers should actively involve students in the learning process so as to enable them (students) to discover their strengths and weaknesses and to devise a means of improving on their weaknesses.

Keywords: Metacognitive, Assessment Strategy, Achievement, Retention, Chemistry, Secondary School Students

Introduction

Chemistry contributes generally to the attainment of goals and objectives of education and specifically help individuals to develop effective product skills, critical thinking and competence required for dealing with observation, classification, measurement, counting numbers, recording, communication, prediction, hypotheses, inference, experimentation, interpretation of data, controlling variables and generalization(Ohodo, 2005). The importance of the application of Chemistry in the society cannot be over-emphasized. Chemists have developed a live-saving pharmaceutical and chemical pesticide to help eradicate deadly disease such as Ebola, HIV, Sickle Cell, among others to humans and crops thereby saving millions of lives. Application of Chemistry is also vital in the production of synthetic fibers which is useful in both industrial and consumer products. Chemistry is also important in the processing and the conservation of processed foods and beverages, in the production of textiles, adhesives, paints and pigments. The knowledge of Chemistry also helps in the purification of water for township supply (Akinsola & Igwe 2002).

Based on the numerous relevance of Chemistry to different aspects of human lives, one would expect that enrollment and performance of secondary school students in Chemistry will be encouraging. However, studies have shown that the performance of students in Chemistry at the secondary school level is still low as reported by West African Senior School Certificate Examination Chief Examiners Report of 2011 2012./2013.and 2014. The poor achievement of students in Chemistry have been attributed to many factors such as lack of adequate instructional materials (Chado Wushishi & Sunday, 2014), poor attitude towards science (Olatunde, 2009), inadequate laboratory facilities (Franyo, 2007) and poor method of instruction, (Mandor in &Chado 2016). Although many factors have been identified to be responsible for the low achievement of students in Chemistry, Mandor in Chado (2016) identified poor method of instruction as the key factor that affects students in Chemistry. This can be attributed to the fact that most Chemistry teachers tend to adopt teaching strategies that are mainly teacher centered, where the teacher dominates the lesson and the students remain passive listeners to the teachers' explanation and demonstrations.

Although several studies had been conducted on the effects of some instructional strategies in teaching Chemistry, such as inquiry method, Ogunleye and Bandele (2013); cooperative learning, Chado, Wushishi and Sunday (2014); game-based learning John(2013) and Concept map Adigwe, Ifeoma & Okonkwo (2013). However, the low achievement of students in Chemistry persists over the year (Fatokun, 2012 & Chado, 2016). Therefore, there is the need to adopt a strategy that will allow the students to get fully involved in monitoring their own

progress and deficiencies in the learning process. One of such methods is the metacognitive self-assessment strategy. Metacognitive self-assessment strategy is a strategy which enables the students to take control of the thinking process when solving problems in science, especially Chemistry.

Bouncristiani and Bouncristiani (2008) defined metacognition as the conscious application of an individual's thinking to their thought process with the specific intention of understanding, monitoring, evaluating and regulating those processes. Rivers (2001) defined metacognitive self assessment as a self-monitoring approach in which learners get involved in the assessment of their own progress and deficiencies in the process of learning. Coutinho (2008) suggested that metacognitive development is crucial for different categories of students. Kuiper (2002) observed that students who are exposed to metacognitive self assessment skills have shown to persist more on difficult task, and confident in their ability to take greater responsibility for their learning tasks. Similarly, in a study conducted by Ibe (2009) on the effect of metacognitive strategies on classroom participation and students' achievement in senior secondary school science classrooms, the results indicate that metacognitive strategies are most effective in enhancing academic achievement.

Researchers however, have different opinions regarding the role of gender to students' achievement in Chemistry, some suggested that male students achieve better than females while others are of the opinion that females achieve better than males; some argued that gender has no effect on students' Chemistry achievement. Kador (2001) and Adigwe, Ifeoma & Okonkwo (2013) reported that male students achieved significantly better than their female counterparts. However, Okeke (2007) and Nzewi (2010) argued that female students achieved higher than their male counterparts when given equal opportunities.

According to Rahman (2010), the primary goal of education is to promote long term knowledge storage and retrieval, not just memories that fade away after a given lecture or conference. Therefore, Chemistry teachers should adopt teaching strategy that would facilitate transfer knowledge into long-term memory. Bhagwan (2005) asserted that students learn and retain better when they engaged in authentic learning task. Similarly, engaging students in the process of learning that facilitates the development of conceptual understanding enhance the matacognitive capabilities and retention of the learners (Fatokun, 2012). The submissions show that adopting student-centered methods like metacognitive self-assessment strategy enhances students' memory retention in the learning of Chemistry. Therefore, this study examines the effect of metacognitive self assessment strategy on students' achievement and retentions of Chemistry concepts.

The problem

The application of Chemistry is useful for the production of synthetic fibre for both domestic and industrial use, in the production of textile as well as the processing and conservation of processed foods. Despite the importance of Chemistry to the development of the nation the West African Senior School Certificate Examination Chief Examiner's Reports of 2011, 2012, 2013 and 2014 revealed low achievement of students in Chemistry. This may be partly due to the instructional strategies adopted by teachers in teaching Chemistry in secondary schools. However, Kuiper (2002) and Ibe (2009) suggested the use of strategy that will enable students to monitor their progress in the process of learning. One of such strategies is metacognitive self assessment strategy which have been found to encourage self assessment and social interaction among the students This study examines the effects of metacognitive self assessment strategy on achievement and retention among secondary school students in Minna. Niger state, Nigeria.

Research Questions

The following research questions are addressed in this study:

i. Is there any difference between the mean achievement scores of students exposed to metacognitive self- assessment strategy and those exposed to conventional method of teaching?
ii. Is there any difference between the mean achievement scores of male and female students exposed to metacognitive self assessment strategy method of teaching?
iii. Is there any significant difference between the mean retention scores of students exposed to metacognitive self- assessment strategy and those exposed to conventional method of teaching?
iv. Is there any difference between the mean retention scores of male and female students exposed to metacognitive self-assessment strategy method of teaching?

Null Hypotheses

The following null hypotheses are tested at ≤ 0.05 level of significance

HO_1 There is no significant difference between the mean achievements score of those exposed to metacognitive self-assessment strategy method of teaching.

HO_2: There is no significant difference between the mean achievement scores of male and female students taught chemistry with metacognitive self-assessment strategy.

HO_3: There is no significant difference between the mean retention scores of students taught Chemistry using metacognitive self assessment strategy and those taught using conventional method of teaching.

HO_4: There is no significant difference between the mean retention scores of male and female students taught chemistry using metacognitive self-assessment strategy.

Methodology

The study adopts quasi-experimental design using pretest- posttest non randomized control group design. The population of the study comprises all the 7051 Senior Secondary School (SS II) students that registered in the public schools in Minna metropolis (2015/2016 session). Random sampling technique was used to sample four co-educational public schools in Minna Metropolis. The schools were randomly assigned into experimental and control groups. A total of 152 students, 78 males and 74 females from both the experimental and control groups participated in the study. Chemistry Achievement Test (CAT) and Chemistry Retention Test (CRT) were constructed by the researcher. The CAT is a multiple choice instrument consisting of 30 items with four options. The face and content validity of CAT were determined by experts in chemistry education to ascertain the suitability and content coverage of the instrument and the reliability coefficient of 0.81 was established using Kurder-Richardson (KR-20). Chemistry Achievement Test was administered as pre-test, to ascertain the entry behaviour of the groups before the administration of treatment while post-test was administered after treatment was administered .on the experimental group. The CAT questions were reshuffled and were administered as Chemistry Retention Test (CRT) on the groups after two weeks. The study lasted for six weeks. Data collected were analyzed using mean, standard deviation and t- test statistics.

Results

Table 1.Pretest t-test Results of the Experimental and Control Groups

Groups	N	Df	Mean	Std. Deviation	t-value	Sig
Experimental	78	150	8.37	2.45	0.268	.789*
Control	74		8.27	2.21		

*Not significant at P≤0.05

Table 1 displays the t-test analysis of the mean achievement scores of the experimental and control groups in the pretest. It shows that t (150) = .268. P< 0.05. This automatically reveals that there is no significant difference between the mean achievement scores of the two groups in the pretest. This means they are of the same level of entry behaviour.

HO_1 There is no significant difference between the mean achievement scores students exposed to metacognitive self-assessment strategy and those exposed to conventional method of teaching

Table 2. Posttest t-test Analysis of the Difference in the Mean Scores of the Experimental and Control groups

Groups	N	Df	Mean	Std. Deviation	t-value	Sig
Experimental	78	150	22.06	2.381	0. 741	.001*
Control	74		15.46	2.428		

*Significant at P≤ 0.05

Table 2 gives detailed of t-test statistic of the difference in the mean achievement scores of the experimental and control groups in the posttest. From the analysis, t (150) =0.741, P< 0.05.Hence the null hypothesis is rejected, as it is clear that there is significant difference between the mean achievement score of students taught chemistry using metacognitive self-assessment strategy and those taught with conventional method of teaching in favour of the experimental group.

HO_2: There is no significant difference between the mean achievement scores of male and female students taught chemistry with metacognitive self-assessment strategy method of teaching

Table 3. Posttest t-test Analysis of the Difference in the Mean Scores of Males and Females Taught Using Metacognitive Self-Assessment Strategy

Gender	N	Df	Mean	Std. Deviation	t-value	Sig
Males	36	76	23.72	2.31	-.141	. 163
Females	42		24.24	1.96		

Table 3 reveals the t-test results of the difference in posttest mean scores of males and females in the experimental group. From the table, male students got a mean score of 23.72, standard deviation of 2.31, while the female students obtained mean score of 24.44, t (76) = -0.141, P<0.05.Therefore, the null hypothesis is retained. This implies that there is no significant difference in the mean scores of male and female students taught Chemistry with metacognitive self-assessment strategy.

HO_3: There is no significant difference between the mean retention scores of students taught Chemistry using metacognitive self assessment strategy and those taught using conventional method of teaching

Table 4. Posttest t-test Analysis of the Difference in the Mean Retention Scores of the Experimental and Control groups

Gender	N	Df	Mean	Std. Deviation	t-value	Sig
Experimental	78	150	22.06	2.381	0.741	0.001
Control	74		15.46	2.428		

*Significant at< P 0.05

Table 4 gives detail of t-test statistics of the difference in the mean retention scores of the experimental and control groups in the post posttest. From the analysis, t(150) = .741, P< 0.05.Hence the null hypothesis is rejected, as it is clear that there is significant difference between the mean retention score of students taught chemistry using metacognitive assessment strategy and those taught with conventional method of teaching in favour of the experimental group

HO_4: There is no significant difference between the retention mean scores of male and female students taught chemistry using metacognitive self-assessment strategy

Table 5: t-test Analysis of the Retention Mean Scores of Male and Female Students Taught Chemistry using Metacognitive self-assessment Strategy

Gender	N	Df	Mean	Std. Deviation	t-value	Sig
Males	36	76	21.97	2.31	-.314	0.755
Females	42		22.14	2.47		

Table 5 provides the analysis of the difference in the mean retention scores of male and female students in the experimental group. Males students obtained mean of 21.97, while female students obtained mean of 22.14,.t(76) -.314, P> 0.05.Thus it shows that there is no significant difference between the mean retention scores of male and female students taught chemistry with metacognitive self-assessment strategy teaching method.

Discussion

The result further shows that student who were exposed to metacognitive self-assessment strategy performed significantly better than those who were exposed to conventional teaching method. This may be attributed to the fact that metacognitive self assessment strategy enables students to get fully involved in the learning process by setting their own learning goals for themselves, think of ways to get through difficult processes individually or collectively and proffering solutions to problems. This strategy allows the students to think of different methods of solving problems. And if they fail, they come together and think of alternative ways of solving the problem. The students also found it exciting to do the thinking and carryout activities that otherwise be done by their teachers in a traditional method of teaching. The findings of this study is in agreement with the finding of Ibe (2009), which shows that metacognitive self assessment strategy is most effective in enhancing academic achievement. It is also in agreement with the assertion of Kuiper (2002) who opined that learners who are exposed to metacognitive self assessment strategy have been shown to persist more on difficult tasks.

The findings from the study also reveals that the strategy is gender friendly because both male and female students who were exposed to the strategy performed equally well. The result of this finding contradicts the findings of Kador (2001) Usman and Ubah in Chad (2016) who reported that male students performed significantly better than their male counterparts. However, it is in agreement with the findings of Okeke (2007) and Nzewi (2010) that female students performed as high as their male counterparts when given equal opportunities. Students' memory retention has also improved by the use of the strategy because of their active engagement in the learning process. The researchers observed that students taught using the strategy have better memory retention than students taught using conventional strategy. This assertion is supported by the findings of Bhagwan, (2005) which state that students learn and retain better when they are engaged in authentic learning task.

Findings of this study have generally revealed that metacognitive self-assessment strategy is effective in enhancing the academic achievement of students in Chemistry. It also improves their memory retention and it can equally be used on both male and female students.

Conclusion

From the findings of this study, it is obvious that metacognitive self assessment strategy plays a vital role in the learning outcome of students in secondary school. The results of the study reveal that students who were taught Chemistry using metacognitive self assessment strategy achieved more than those taught using conventional method of teaching and also they have longer memory retention because of their involvement in the learning process. Therefore, Chemistry teachers should be encouraged to use metacognitive self assessment strategy in teaching concepts in science especially Chemistry.

Recommendations

The researchers make the following recommendations based on the findings of this study:

i. Chemistry teachers should be equipped with metacognitive self assessment skills through seminars and workshops in order guide the students in acquiring such skills so as to achieve their learning goals.
ii. Chemistry teachers should actively involve students in the learning process so as to enable the students to discover their strengths and weaknesses and to devise a means of improving on their weaknesses.

iii. Parents should encourage their children or wards by providing necessary supports for their independent learning

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